CLAIMS

I/We claim:

[c1] 1. An electrochemical deposition chamber for depositing material onto microfeature workpieces, the chamber comprising:

a processing unit including a first flow system configured to convey a flow of a first processing fluid to a microfeature workpiece at a processing site;

an electrode unit including an electrode compartment and a second flow system separate from the first flow system, the second flow system being configured to convey a flow of a second processing fluid through the electrode compartment;

a plurality of independent electrodes in the electrode compartment; and

a barrier between the processing unit and the electrode unit to inhibit selected matter from passing between the first and second processing fluids.

[c2] 2. The chamber of claim 1 wherein:

the electrodes comprise a first electrode and a second electrode; and

the electrode unit further comprises a dielectric divider between the first electrode and the second electrode.

[c3] 3. The chamber of claim 1 wherein:

the electrodes comprise a first electrode and a second electrode arranged concentrically with the first electrode; and

the processing unit further comprises a field shaping module, the field shaping module being composed of a dielectric material and having a first opening facing a first section of the processing site through which ions influenced by the first electrode can pass and a second

opening facing a second section of the processing site through which ions influenced by the second electrode can pass.

[c4] 4. The chamber of claim 1 wherein the barrier is a nonporous barrier that prevents nonionic species from passing between the first and second processing fluids.

[c5] 5. The chamber of claim 1 wherein the barrier is a semipermeable barrier that allows either cations or anions to pass through the barrier between the first and second processing fluids.

[c6] 6. The chamber of claim 1 wherein the barrier is a semipermeable barrier that separates the flow of the first processing fluid from the flow of the second processing fluid.

[c7] 7. The chamber of claim 1 wherein the barrier is a permeable barrier that permits fluid flow between the first and second processing fluids.

[c8] 8. The chamber of claim 1 wherein the barrier allows electrical current to pass therethrough in the presence of an electrolyte.

[c9] 9. The chamber of claim 1 wherein:

the electrodes selectively induce corresponding electrical fields; and

the processing unit further comprises a field shaping module that shapes the electrical fields induced by the electrodes.

[c10] 10. The chamber of claim 1 wherein:

the electrodes comprise a first electrode and a second electrode; and

the electrode unit further comprises a first electrical connector coupled to the first electrode and a second electrical connector coupled to the

second electrode, the first and second electrodes being operable independently of each other.

[c11] 11. The chamber of claim 1, further comprising:

the first processing fluid, wherein the first processing fluid has a concentration of between approximately 10 g/l and approximately 200 g/l of acid; and

the second processing fluid, wherein the second processing fluid has a concentration of between approximately 0.1 g/l and approximately 200 g/l of acid.

[c12] 12. The chamber of claim 11 wherein the second processing fluid has a concentration of between approximately 0.1 g/l and approximately 1.0 g/l of acid.

[c13] 13. The chamber of claim 1, further comprising:

the first processing fluid, wherein the first processing fluid has a first concentration of acid; and

the second processing fluid, wherein the second processing fluid has a second concentration of acid, the ratio of the first concentration to the second concentration being between approximately 1:1 and approximately 20,000:1.

[c14] 14. The chamber of claim 1 wherein the barrier is canted relative to the processing unit to vent gas from the second processing fluid.

[c15] 15. The chamber of claim 1, further comprising a barrier unit coupled to the processing and electrode units, the barrier unit including the barrier.

[c16] 16. The chamber of claim 1 wherein:

the barrier includes a first side and a second side opposite the first side;

the first flow system is configured to flow the first processing fluid at least proximate to the first side of the barrier; and

the second flow system is configured to flow the second processing fluid at least proximate to the second side of the barrier.

[c17] 17. The chamber of claim 1 wherein the electrodes comprise a pure copper electrode.

[c18] 18. The chamber of claim 1 wherein the electrodes comprise a copper-phosphorous electrode.

[c19] 19. An electrochemical deposition chamber for depositing material onto microfeature workpieces, the chamber comprising:

a head assembly including a workpiece holder configured to position a microfeature workpiece at a processing site and a plurality of electrical contacts arranged to provide electrical current to a layer on the workpiece; and

a vessel including (a) a processing unit for carrying one of a catholyte and an anolyte proximate to the workpiece, (b) an electrode unit having a plurality of electrodes and being configured to carry the other of the catholyte and the anolyte at least proximate to the electrodes, and (c) a barrier between the processing unit and the electrode unit to separate the catholyte and the anolyte.

[c20] 20. The chamber of claim 19 wherein the barrier is a semipermeable barrier that allows either cations or anions to pass through the barrier between the first and second processing fluids.

[c21] 21. The chamber of claim 19 wherein the barrier is a permeable barrier that permits fluid flow between the catholyte and the anolyte.

[c22] 22. The chamber of claim 19 wherein the barrier is a nonporous barrier that separates a flow of the catholyte and a flow of the anolyte.

[c23] 23. The chamber of claim 19 wherein:

the electrodes comprise a first electrode and a second electrode; and

the electrode unit further comprises a dielectric divider between the first electrode and the second electrode.

[c24] 24. A tool for wet chemical processing of microfeature workpieces, the tool comprising:

a processing unit for conveying a first processing fluid to a microfeature workpiece;

an electrode unit including a plurality of electrodes;

a barrier unit between the processing and electrode units, the barrier unit including a barrier;

a first flow system for carrying the first processing fluid, the first flow system including a first portion in the processing unit and a second portion in the barrier unit in fluid communication with the first portion in the processing unit; and

a second flow system for carrying a second processing fluid at least proximate to the electrodes, the second flow system including a first portion in the electrode unit and a second portion in the barrier unit in fluid communication with the first portion in the electrode unit, wherein the barrier is between the first processing fluid in the first flow system and the second processing fluid in the second flow system.

[c25] 25. A chamber for wet chemical processing of microfeature workpieces, the chamber comprising:

a first processing fluid having a concentration of between approximately 10 g/l and approximately 200 g/l of acid;

a processing unit carrying the first processing fluid and being configured to convey the first processing fluid to a microfeature workpiece;

a second processing fluid having a concentration of between approximately 0.1 g/l and approximately 1.0 g/l of acid;

an electrode unit carrying a plurality of electrodes and the second processing fluid proximate to the electrodes; and

a barrier between the processing unit and the electrode unit to separate the first and second processing fluids.

[c26] 26. The chamber of claim 25 wherein the first and second processing fluids each have a concentration of between approximately 10 g/l and approximately 50 g/l of copper.

[c27] 27. The chamber of claim 25 wherein the barrier is a nonporous barrier that separates a flow of the first processing fluid from a flow of the second processing fluid.

[c28] 28. The chamber of claim 25 wherein the barrier is a porous barrier that permits fluid flow between the first and second processing fluids while preventing organic additives from passing through the barrier.

[c29] 29. A chamber for wet chemical processing of microfeature workpieces, the chamber comprising:

a first processing fluid having a first concentration of acid;

a processing unit carrying the first processing fluid and being configured to convey the first processing fluid to a microfeature workpiece;

a second processing fluid having a second concentration of acid, the ratio of the first concentration to the second concentration being between approximately 10:1 and approximately 20,000:1;

an electrode unit carrying a plurality of electrodes and the second processing fluid proximate to the electrodes; and

a barrier between the processing unit and the electrode unit to inhibit organic additives from passing between the first and second processing fluids.

[c30] 30. The chamber of claim 29 wherein the barrier is a nonporous barrier that separates a flow of the first processing fluid from a flow of the second processing fluid.

[c31] 31. The chamber of claim 29 wherein the barrier is a porous barrier that permits fluid flow between the first and second processing fluids.

[c32] 32. The chamber of claim 29 wherein the first and second processing fluids each have a concentration of between approximately 10 g/l and approximately 50 g/l of copper.

[c33] 33. A system for wet chemical processing of microfeature workpieces, the system comprising:

a processing unit for conveying a first electrolyte to a microfeature workpiece;

a first reservoir in fluid communication with the processing unit, the first reservoir and the processing unit being configured to carry a first volume of the first electrolyte;

an electrode unit for carrying a second electrolyte and a plurality of electrodes proximate to the second electrolyte;

a second reservoir in fluid communication with the electrode unit, the second reservoir and the electrode unit being configured to carry a second volume of the second electrolyte, the first volume of the first electrolyte being at least twice the second volume of the second electrolyte; and

a barrier between the processing unit and the electrode unit to divide the second electrolyte and the first electrolyte.

[c34] 34. The system of claim 33 wherein the ratio of the first volume of the first electrolyte to the second volume of the second electrolyte is between approximately 1.5:1 and approximately 10:1.

[c35] 35. The system of claim 33, further comprising:

the first electrolyte, wherein the first electrolyte has a concentration of between approximately 10 g/l and approximately 200 g/l of acid; and

the second electrolyte, wherein the second electrolyte has a concentration of between approximately 0.1 g/l and approximately 1.0 g/l of acid.

[c36] 36. The system of claim 33, further comprising:

the first electrolyte, wherein the first electrolyte has a concentration of between approximately 10 g/l and approximately 50 g/l of copper; and

the second electrolyte, wherein the second electrolyte has a concentration of between approximately 10 g/l and approximately 50 g/l of copper.

[c37] 37. A method of electrochemically processing a microfeature workpiece, comprising:

flowing a first processing fluid at least proximate to a microfeature workpiece in a reaction chamber;

flowing a second processing fluid at least proximate to a plurality of electrodes in the reaction chamber;

applying independent electrical currents to individual electrodes to establish an electrical current flow in the first and second processing fluids; and

separating the first processing fluid and the second processing fluid with a barrier.

[c38] 38. The method of claim 37 wherein separating the first and second processing fluids comprises separating a flow of the first processing fluid from a flow of the second processing fluid.

[c39] 39. The method of claim 37 wherein separating the first and second processing fluids comprises separating the first and second processing fluids with a porous barrier to inhibit organic additives from passing between the first and second processing fluids.

[c40] 40. The method of claim 37 wherein separating the first and second processing fluids comprises separating the first and second processing fluids with a barrier that allows electrical current to pass therethrough in the presence of an electrolyte.

[c41] 41. The method of claim 37 wherein:

flowing the first processing fluid comprises flowing a catholyte having a concentration of between approximately 10 g/l and approximately 200 g/l of acid; and

flowing the second processing fluid comprises flowing an anolyte having a concentration of between approximately 0.1 g/l and approximately 1.0 g/l of acid.

[c42] 42. The method of claim 37 wherein:

flowing the first processing fluid comprises flowing a catholyte having a first concentration of acid; and

flowing the second processing fluid comprises flowing an anolyte having a second concentration of acid, the ratio of the first concentration of acid to the second concentration of acid being between approximately 10:1 and approximately 20,000:1.

[c43] 43. The method of claim 37 wherein applying independent electrical currents to individual electrodes comprises applying a first current to a first electrode and a second current different than the first current to a second electrode.

[c44] 44. The method of claim 37, further comprising varying the electrical currents dynamically during a plating cycle.

[c45] 45. The method of claim 37 wherein:

the first processing fluid is a first charge carrying fluid for carrying a first charge across the barrier; and

the second processing fluid is a second charge carrying fluid for carrying a second charge across the barrier.

[c46] 46. The method of claim 45 wherein the first and second charge carrying fluids include anions.

[c47] 47. The method of claim 45 wherein the first and second charge carrying fluids include cations.

[c48] 48. The method of claim 45 wherein charge carriers in the first and second charge carrying fluids move in opposite directions when the reaction chamber is operating and idle.

[c49] 49. A method of electrochemically processing a microfeature workpiece, comprising:

flowing a first processing fluid at least proximate to a microfeature workpiece in an electrochemical deposition chamber;

flowing a second processing fluid at least proximate to a plurality of electrodes in the electrochemical deposition chamber;

applying electrical potentials to individual electrodes to establish an electrical current flow in the first and second processing fluids; and

inhibiting organic additives from passing through a barrier between the first processing fluid and the second processing fluid.

[c50] 50. A method of electrochemically processing a microfeature workpiece, comprising:

flowing a first processing fluid having a concentration of between approximately 10 g/l and approximately 200 g/l of acid at least proximate to a microfeature workpiece in a wet chemical processing tool;

flowing a second processing fluid having a concentration of between approximately 0.1 g/l and approximately 1.0 g/l of acid at least proximate to a plurality of electrodes in the wet chemical processing tool;

applying independent electrical currents to individual electrodes to establish an electrical current flow in the first and second processing fluids; and

separating the first processing fluid and the second processing fluid with a barrier.

[c51] 51. A method of electrochemically processing a microfeature workpiece, comprising:

flowing a first processing fluid having a first concentration of acid at least proximate to a microfeature workpiece in a wet chemical processing tool;

flowing a second processing fluid having a second concentration of acid at least proximate to a plurality of electrodes in the wet chemical processing tool, the ratio of the first concentration of acid to the second concentration of acid being between approximately 10:1 and approximately 20,000:1;

applying independent electrical potentials to individual electrodes to establish an electrical current flow in the first and second processing fluids; and

dividing the first and second processing fluids with a barrier.

[c52] 52. A method of electrochemically processing a microfeature workpiece, comprising:

flowing catholyte through a first flow system of a wet chemical processing tool and at least proximate to a microfeature workpiece, the first flow system being configured to carry a first volume of catholyte;

flowing anolyte through a second flow system of the wet chemical processing tool and at least proximate to a plurality of electrodes, the second flow system being configured to carry a second volume of anolyte, the first volume of catholyte being at least twice the second volume of anolyte;

applying independent electrical potentials to individual electrodes to establish an electrical current flow in the first and second processing fluids; and

separating the catholyte and the anolyte with a barrier.